WE CLAIM:

1. A network element arranged to be coupled within a working path of an optical network, the network element comprising:

a plurality of ports including first and second ports arranged to be coupled to Optical Carrier (OC) links within the working path;

a switch fabric connected to the plurality of ports and configured to couple the first and second ports such that data traffic received on one of the first and second ports is output on the other; and

a control unit, connected to the switch fabric, that operates to monitor for a failure within the working path and, if a failure is detected in the working path, to determine protection switching data corresponding to the failure and to insert the protection switching data within the data traffic being output from at least one of the first and second ports.

2. A network element according to claim 1, wherein the data traffic comprises a plurality of data units, each data unit comprising a path overhead that further comprises at least one protection byte; and

wherein to insert the protection switching data within the data traffic, the control unit inserts the protection switching data within the at least one protection byte.

3. A network element according to claim 2, wherein each of the data units comprises a Synchronous Transport Signal Level 1 (STS-1) and the at least one protection byte

comprises at least one of the Z3 and Z4 bytes defined within the path overhead of each STS-1.

4. A network element according to claim 1 further comprising a routing table that includes at least one protection entry;

wherein to determine protection switching data corresponding to the failure, the control unit operates to look-up a protection entry within the routing table corresponding to the failure within the working path, the protection entry comprising the protection switching data.

5. A network element according to claim 1, wherein the protection switching data comprises a plurality of switching instructions for switch fabrics within network elements associated with a protection path for the data traffic.

6. A network element according to claim 5, wherein the plurality of ports further includes a third port arranged to be coupled to a protection path OC link;

wherein a switching instruction within the protection switching data dictates the reconfiguration of the switch fabric such that the first and third ports are coupled together; and

wherein, if a failure is detected within the working path, the control unit further operates to reconfigure the switch fabric according to the corresponding switching instruction.

7. A network element according to claim 1, wherein the data traffic is defined by the Synchronous Optical Network (SONET) standard.

8. A network element according to claim 1, wherein the data traffic is defined by the Synchronous Digital Hierarchy (SDH) standard.

9. A network element arranged to be assigned within a protection path of an optical network, the network element comprising:

a plurality of ports;

a switch fabric connected to each of the ports; and

a control unit, connected to the switch fabric, that operates to monitor for changes in protection switching data within data traffic received at one of the ports and, if the protection switching data has changed, to process the protection switching data in order to determine if any switching instructions within the protection switching data relate to the network element and, if at least one of the switching instructions relate to the network element, to reconfigure the switch fabric according to the switching instruction related to the network element such that the network element is configured within a protection path of the optical network.

10. A network element according to claim 9, wherein the data traffic comprises a plurality of data units, each data unit comprising a path overhead that further comprises at least one protection byte; and

wherein the protection switching data within the data traffic is located within the at least one protection byte.

11. A network element according to claim 10, wherein each of the data units comprises a Synchronous Transport Signal Level 1 (STS-1) and the at least one protection byte comprises at least one of the Z3 and Z4 bytes defined within the path overhead of each STS-1.

12. A network element according to claim 9, wherein the plurality of ports include first and second ports arranged to be coupled to Optical Carrier (OC) links within a working path;

wherein the switch fabric is configured to couple the first and second ports such that data traffic received on one of the first and second ports is output on the other; and

wherein the control unit further operates to monitor for a failure within the working path and, if a failure is detected in the working path, to determine protection switching data corresponding to the failure and to insert the protection switching data within the data traffic being output from at least one of the first and second ports.

13. A network element according to claim 12 further comprising a routing table that includes at least one protection entry;

wherein to determine protection switching data corresponding to the failure, the control unit operates to

look up a protection entry within the routing table corresponding to the failure within the working path, the protection entry comprising the protection switching data.

14. A network element according to claim 9, wherein the data traffic is defined by the Synchronous Optical Network (SONET) standard.

15. A network element according to claim 9, wherein the data traffic is defined by the Synchronous Digital Hierarchy (SDH) standard.

16. A method for establishing an optical communication network of network elements and Optical Carrier (OC) links, the method comprising:

configuring a working path for data traffic between a first path-terminating network element and a second path terminating network element via a first set of the OC links; and

assigning at least one protection path for data traffic between the first network element and the second network element via a second set of the OC links, the assigning at least one protection path comprising:

inserting protection entries into routing tables within network elements that can detect failures within the working path, the protection entries comprising protection switching data that indicates switch fabric modifications necessary to configure the protection path between the first network element and the second network element.

17. A method according to claim 16, wherein the configuring a working path for data traffic comprises configuring switch fabrics within a plurality of the network elements to transmit the data traffic through the working path.

18. A method according to claim 17, wherein the configuring a working path for data traffic further comprises reserving bandwidth for the data traffic to traverse the first set of OC links.

19. A method according to claim 16, wherein the assigning at least one protection path for data traffic further comprises reserving bandwidth for the data traffic to traverse the second set of OC links.

20. A method according to claim 16, wherein the assigning at least one protection path for data traffic comprises assigning a plurality of protection paths for data traffic from the first network element to the second network element via a plurality of corresponding sets of OC links.

21. A method for configuring a pre-assigned protection path within an optical network during a failure within a pre-configured working path, the method comprising:

monitoring for a failure indication within the pre-configured working path; and

if a failure indication is detected within the working path:

determining protection switching data corresponding to the failure;

transporting the protection switching data within the data traffic to the network elements of the protection path; and

processing the protection switching data at each of the network elements that requires reconfiguration such that their corresponding switch fabrics are reconfigured.

22. A method according to claim 21, wherein the data traffic comprises a plurality of data units, each data unit comprising a path overhead that further comprises at least one protection byte; and

wherein the transporting the protection switching data within the data traffic comprises inserting the protection switching data within the at least one protection byte of the path overhead and forwarding the data traffic.

23. A method according to claim 22, wherein each of the data units comprises a Synchronous Transport Signal Level 1 (STS-1) and the at least one protection byte comprises at least one of the Z3 and Z4 bytes defined within the path overhead of each STS-1.

24. A method according to claim 21, wherein the determining protection switching data corresponding to the failure comprises looking-up a protection entry within a routing table corresponding to the failure indication, the protection entry comprising the protection switching data.

25. A method according to claim 21, wherein the protection switching data comprises a plurality of switching

instructions for the network elements of the protection path that require switching.

26. An optical communication network of network elements coupled together with Optical Carrier (OC) links, the optical communication network comprising:

a working path comprising a first set of OC links and network elements that are configured to transmit data traffic between first and second path-terminating network elements; and

at least one protection path comprising a second set of OC links and network elements that are assigned to transmit data traffic between the first and second path-terminating network elements if a failure is detected on the working path;

wherein routing tables within the network elements of the working path comprise a protection entry that dictates switching instructions that must be applied to the network elements of the protection path to configure the protection path.

27. A network according to claim 26, wherein, if a failure occurs within the working path, at least one of the network elements of the first set operates to detect the failure, to determine protection switching data by looking up the corresponding protection entry within its routing table and to insert the determined protection switching data including its switching instructions into the data traffic.

28. A network according to claim 26, wherein the data traffic comprises a plurality of data units, each data unit

comprising a path overhead that further comprises at least one protection byte; and

wherein to insert the determined protection switching data into the data traffic, the particular network element operates to insert the protection switching data within the at least one protection byte.

29. A network according to claim 28, wherein each of the data units comprises a Synchronous Transport Signal Level 1 (STS-1) and the at least one protection byte comprises at least one of the Z3 and Z4 bytes defined within the path overhead of each STS-1.

30. A network according to claim 26, wherein each of the
network elements within the first set comprises a switch fabric configured to transmit the data traffic through the working path.

31. A network according to claim 26, wherein each of the OC links within the first set comprises reserved bandwidth for the data traffic to traverse the working path.

32. A network according to claim 26, wherein each of the OC links of the second set comprises reserved bandwidth for the data traffic to traverse the protection path.

33. A network according to claim 26, wherein at least one of the network elements of the first set is within the second set.

34. A network according to claim 26, wherein the data traffic is defined by the Synchronous Optical Network (SONET) standard.

35. A network according to claim 26, wherein the data traffic is defined by the Synchronous Digital Hierarchy (SDH) standard.

36. A network element arranged to be coupled within a working path of an optical network, the network element comprising:

means for monitoring for a failure within the working path;

means for determining protection switching data corresponding to the failure if a failure is detected in the working path;

means for inserting the determined protection switching data within data traffic; and

means for outputting the data traffic with the determined protection switching data inserted.

37. A network element arranged to be assigned within a protection path of an optical network, the network element comprising:

means for receiving data traffic;

means for monitoring for changes in protection switching data within the received data traffic; and

means for processing the protection switching data in the case that the protection switching data has changed; and

wherein the means for processing the protection switching data comprises means for reconfiguring the network element in the case that the protection switching data comprises a switching instruction related to the network element.

38. A data frame comprising:

a transport overhead; and

a Synchronous Payload Envelope (SPE), the SPE comprising a path overhead and a payload;

wherein protection switching data is inserted within the path overhead.

39. A data frame according to claim 38, wherein the protection switching data is inserted within at least one of the Z3 and Z4 bytes within the path overhead.

40. A data frame according to claim 38, wherein the data frame is a Synchronous Optical NETwork (SONET) frame.

41. A data frame according to claim 38, wherein the data frame is a Synchronous Digital Hierarchy (SDH) frame.